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FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
FITZPATRICK, ATIBA O	

ART UNIT	PAPER NUMBER
2624	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/563,957	FUNAYAMA ET AL.	
	Examiner	Art Unit	
	ATIBA O. FITZPATRICK	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _31 March 2009_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-10 and 23-29_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-10 and 23-29_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

The objections to claims 1 and 5 are withdrawn in light of the amendments. The objection to the title is maintained. Applicant has amended the title from “IMAGE PROCESSING APPARATUS, IMAGE PROCESSING METHOD, IMAGE PROCESSING PROGRAM, AND RECORDING MEDIUM” to “IMAGE PROCESSING APPARATUS”. However, this amendment has not made it such that title is clearly indicative of the invention to which the claims are directed. The phrase "image processing apparatus" is fairly broad and would encompass any application that includes some form of image processing. As such, this phrase cannot be an appropriate title. An appropriate title would clearly indicate to the reader what Applicant regards as his or her invention as reflected in the claims. Applicant’s invention is apparently drawn to estimating a motion of a predetermined feature point using image processing as is indicated in the preamble of claim 1.

Applicant's arguments pertaining to the prior art rejections have been fully considered but they are not persuasive. Applicant argues that the Heinzmann reference teaches away from the claimed invention and particularly the added limitations: “uses a perspective transformation”. However, in examining the teachings present in page 144, column 1, paragraph 5, one can readily determine that Applicant’s conclusions are incorrect. Firstly, in the instant paragraph, Heinzmann teaches that "Two different transformations <u>may be used</u> for pose estimation from monocular data: <u>perspective or</u>

affine transformation. The perspective transformation precisely models the actual projection of a 3-D scene to the image plane". Therefore, Heinzmann presents two alternative embodiments for performing pose estimation. As such, claim 1 is appropriately rejected under 35 USC 102 as being anticipated by the Heinzmann reference. Note that the MPEP makes it clear that the “teaches away” argument is not germane to a 35 USC 102 rejection (MPEP 2131.04). This fact alone renders Applicant’s arguments moot.

Furthermore, even in considering a 35 USC 103 “obvious” rejection of claim 1, Applicant’s arguments are moot. MPEP 2123 II states that “Disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments”. As indicated above, the Heinzmann reference presents two embodiments for pose estimation: perspective and affine transformation. Even if one is to assume arguendo that the perspective transformation is a nonpreferred embodiment (or broader disclosure). Statements pertaining to why a preferred embodiment is preferred do not constitute a teaching away from alternative or nonpreferred embodiments (or broader disclosure) since Heinzmann explicitly states that both “transformations may be used”.

Also, in considering a 35 USC 103 “obvious” rejection of claim 1, the MPEP states that an argument of teaching away is moot when the reference provides motivation for the nonpreferred embodiment (MPEP 2144.05 III). Note that Heinzmann provides the motivation for using a perspective transformation in stating that “The

perspective transformation <u>precisely</u> models the actual projection of a 3-D scene to the image plane”.

Lastly, in considering a 35 USC 103 “obvious” rejection of claim 1, note that the "teaches away" argument pertains to teaching away from the claimed invention. Heinzmann indicates that affine transformation would be more suitable for real-time systems because it has simpler calculations and only a twofold ambiguity and since the required calculations for the perspective transformation are complex and time consuming and can deliver up to a fourfold ambiguity in the estimate of the pose. However, the claims do not require that the claimed invention is a real-time system, so Applicant's arguments are moot.

Specification

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 102

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-9 and 23-29 are rejected under 35 U.S.C. 102(b) as being anticipated by J. Heinzmann and A. Zelinsky, "3-D facial pose and gaze point estimation using a robust real-time tracking paradigm," IEEE Int. Workshop on Automatic Face and Gesture Recognition, pp142-147, 1998) (Heinzmann).

As per claim 1, Heinzmann teaches an image processing apparatus for estimating a motion of a predetermined feature point of a 3D object from a motion picture of the 3D object taken by a monocular camera, comprising **(Limitations present only within the preamble are not given patentable weight)**:

observation vector extracting means for extracting projected coordinates of the predetermined feature point onto an image plane, from each of frames of the motion picture **(Heinzmann: page 142, col 2, para 2: "forwarded to the 2-D model… image plane… 2-D image positions of the features"; Fig. 1)**;

3D model initializing means for making the observation vector extracting means extract from an initial frame of the motion picture, initial projected coordinates in a model coordinate arithmetic expression for calculation of model coordinates of the predetermined feature point on the basis of a first parameter, a second parameter, and the initial projected coordinates **(Heinzmann: Fig. 1; abstract: "3-D model… initialize the feature tracking": paramaters: abstract: "feature positions… gaze direction… head rotation": Fig. 1: "feature positions… relative positions". Fig. 1 shows that the projected coordinates are extracted from the 2-D model into the 3-D model. page 142, col 2, para 2: "2-D image positions of the features are transferred to a 3-D model of the feature locations"; page 144, col 1, para 5 – col 2, para 1 : "affine transformation… a good approximation of perspective projection provided the depth of the object does not exceed 1/10 of the distance between camera and object. This is usually the case in face tracking applications.": Therefore, a parameter is the depth of object which is not expected to exceed 1/10 of the**

distance between the camera and the object; page 144, col 2, paras 2-3: “angle”; page 144, col 2, paras 4-5: “theta… orientations”; Fig. 3: “camera coordinates.. angles”; Fig. 2: “angles”; page 145, col 1, para 3 – col 2, para 1: “distance and orientation”; page 145, col 2, para 2: “depth”. Fig. 4: shows 9 parameters. page 146, col 1, para 3 – col 2, para 1: “Figure 4 shows the output of some tracking parameter including the rotational angles, the displacement, the gaze direction of both eyes and the uncertainty of the face tracking”); and

motion estimating means for calculating estimates of state variables including a third parameter in a motion arithmetic expression for calculation of coordinates of the predetermined feature point at a time of photography when a processed target frame of the motion picture different from the initial frame was taken, from the model coordinates, the first parameter, and the second parameter, and for outputting an output value about the motion of the predetermined feature point on the basis of the second parameter included in the estimates of the state variables **(Heinzmann: page 142, col 2, para 2: “The estimated positions of the features determine the location within the next image frame of the hardware search windows.” Note that the state variables include the parameters that were listed above: page 142, col 2, para 2: “3-D triplets”; Fig. 1: “3-D pose”: output)**,

wherein the model coordinate arithmetic expression is based on back projection of the monocular camera, the first parameter is a parameter independent of a local motion of a portion including the predetermined feature point, and the second parameter is a parameter dependent on the local motion of the portion including the

predetermined feature point **(Heinzmann: page 142, col 2, para 2: "The 3-D model is also projected back into the image plane to adapt the constraints in the 2-D model."; abstract: "monocular"; page 144, col 1, para 5 – col 2, para 1 : "affine transformation… a good approximation of perspective projection provided the depth of the object does not exceed 1/10 of the distance between camera and object. This is usually the case in face tracking applications.": Therefore, a parameter is the depth of object which is not expected to exceed 1/10 of the distance between the camera and the object. This parameter is independent of local motion. Note that parameters are also listed above. page 145, col 2, para 2: "monocular")**, and

wherein the motion estimating means:

calculates predicted values of the state variables at the time of photography when the processed target frame was taken, based on a state transition model **(Heinzmann: page 143, col 2, para 6: "probabilistic relocation of features based on template correlations and a simple 2-D facial model")**;

applies the initial projected coordinates, and the first parameter and the second parameter included in the predicted values of the state variables, to the model coordinate arithmetic expression to calculate estimates of the model coordinates at the time of photography **(Heinzmann: Fig. 1 and 3: Note that every frame corresponds to a time a photography)**;

applies the third parameter in the predicted values of the state variables and the estimates of the model coordinates to the motion arithmetic expression to

calculate estimates of coordinates of the predetermined feature point at the time of photography **(Heinzmann: page 146, col 1, para 1-2: third parameter can be interpreted to be confidence Figs. 1 and 3. See arguments made above for parameters.)**;

applies the estimates of the coordinates of the predetermined feature point to an observation function based on an observation model of the monocular camera to calculate estimates of an observation vector of the predetermined feature point **(Heinzmann: page 146, col 1, para 1-2. Figs. 1 and 3)**;

makes the observation vector extracting means extract the projected coordinates of the predetermined feature point from the processed target frame, as the observation vector **(Heinzmann: page 145, col 1, para 3: "gaze vector"; Figs. 1 and 3; page 146, col 1, para 2: "gaze vector")**;

filters the predicted values of the state variables by use of the extracted observation vector and the estimates of the observation vector to calculate estimates of the state variables at the time of photography **(Heinzmann: Fig. 1: "Kalman filtering". Note that every frame corresponds to a time of photography. As stated above, the state variables include the parameters. A coordinate is an observation vector originating from the origin in the corresponding coordinate space; page 145, col 1, para 3: "gaze vector"; Figs. 1 and 3; page 146, col 1, para 2: "gaze vector… Intersecting G, with a world mode1 yields the gaze point")**; and

uses a perspective transformation **(Heinzmann: See arguments made above. Page 144, col 1, para 5: "Two <u>different transformations may be used</u> for pose**

estimation from monocular data: <u>perspective</u> or affine transformation. The <u>perspective transformation precisely models</u> the actual projection of a 3-D scene to the image plane”).

As per claim 2, Heinzmann teaches the image processing apparatus according to Claim 1, wherein the first parameter is a static parameter to converge at a specific value, and wherein the second parameter is a dynamic parameter to vary with the motion of the portion including the predetermined feature point **(Heinzmann: See arguments made for rejection claim 1: The static parameter can be interpreted to be the length (or depth) of the gaze vector that converges to a specific gaze point (page 146, col 1, para 2).The second dynamic value is the angle or orientation that varies over time along with the motion)**.

As per claim 3, Heinzmann teaches the image processing apparatus according to Claim 2, wherein the static parameter is a depth from the image plane to the predetermined feature point **(Heinzmann: See arguments made for rejection claim 1, 2: The depth of the feature from the image plane is considered as a parameter.)**.

As per claim 4, Heinzmann teaches the image processing apparatus according to Claim 2, wherein the dynamic parameter is a rotation parameter for specifying a rotation motion of the portion including the predetermined feature point **(Heinzmann:**

See arguments made for rejection claim 1, 2: The rotation is considered as a parameter).

As per claim 5, Heinzmann teaches the image processing apparatus according to Claim 4, wherein the rotation parameter is an angle made by a vector from an origin to the predetermined feature point, relative to two coordinate axes in a coordinate system whose origin is at a center of the portion including the predetermined feature point **(Heinzmann: See arguments made for rejection claim 1: page 146, col 1: "eye orientation… alpha_x, alpha_y… origin is located between the eyes")**.

As per claim 6, Heinzmann teaches the image processing apparatus according to Claim 1, wherein the first parameter is a rigid parameter, and wherein the second parameter is a non-rigid parameter **(Heinzmann: See arguments made for rejection claim 1, 2: The depth is the rigid parameter, and the angle/orientation is the non-rigid-parameter. Also, affine and perspective transformations are non-rigid transformation, but the depth would not be affected by the transformations)**.

As per claim 7, Heinzmann teaches the image processing apparatus according to Claim 6, wherein the rigid parameter is a depth from the image plane to the model coordinates **(Heinzmann: See arguments made for rejection claim 1, 6.)**.

As per claim 8, Heinzmann teaches the image processing apparatus according to Claim 6, wherein the non-rigid parameter is a change amount about a position change of the predetermined feature point due to the motion of the portion including the predetermined feature point **(Heinzmann: See arguments made for rejection claim 1, 5.)**.

As per claim 9, Heinzmann teaches the image processing apparatus according to Claim 1, wherein the motion model is based on rotation and translation motions of the 3D object, and wherein the third parameter is a translation parameter for specifying a translation amount of the 3D object and a rotation parameter for specifying a rotation amount of the 3D object **(Heinzmann: See arguments made for rejection claim 1, 2, and 5: Fig. 4: "Disp X… Disp Y": translation; Fig. 1: "template tracking" Template tracking or matching accounts for in-plane translations. Fig. 3: "camera coordinates… angles"; Fig. 1)**.

As per claim 23, Heinzmann teaches the image processing apparatus according to Claim 1, wherein a 3D structure of a center of a pupil on a facial picture is defined by a static parameter and a dynamic parameter, and wherein the a gaze is determined by estimating the static parameter and the dynamic parameter **(Heinzmann: See arguments made for rejection claim 1, 2, 5, 9)**.

As per claim 24, Heinzmann teaches the image processing apparatus according to Claim 23, wherein the static parameter is a depth of the pupil in a camera coordinate system **(Heinzmann: See arguments made for rejection claim 1, 2, 5, 9)**.

As per claim 25, Heinzmann teaches the image processing apparatus according to Claim 23, wherein the dynamic parameter is a rotation parameter of an eyeball **(Heinzmann: See arguments made for rejection claim 1, 2, 5, 9)**.

As per claim 26, Heinzmann teaches the image processing apparatus according to Claim 25, wherein the rotation parameter of the eyeball has two degrees of freedom to permit rotations with respect to two coordinate axes in an eyeball coordinate system **(Heinzmann: See arguments made for rejection claim 1, 2, 5, 9: alpha_x, alpha_y)**.

As per claim 27, Heinzmann teaches the image processing apparatus according to Claim 1, wherein a 3D structure of the 3D object on the a picture is defined by a rigid parameter and a non-rigid parameter and wherein the motion of the 3D object is determined by estimating the rigid parameter and the non-rigid parameter **(Heinzmann: See arguments made for rejection claim 1, 2, 5, 6, 9)**.

As per claim 28, Heinzmann teaches the image processing apparatus according to Claim 27, wherein the rigid parameter is a depth of a feature point of the 3D object in

a model coordinate system **(Heinzmann: See arguments made for rejection claim 1, 2, 5, 6, 9)**.

As per claim 29, Heinzmann teaches the image processing apparatus according to Claim 27, wherein the non-rigid parameter is a change amount of a feature point of the 3D object in a model coordinate system **(Heinzmann: See arguments made for rejection claim 1, 2, 5, 6, 9)**.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 1-10 and 23-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over J. Heinzmann and A. Zelinsky, "3-D facial pose and gaze point estimation using a robust real-time tracking paradigm," IEEE Int. Workshop on Automatic Face and Gesture Recognition, pp142-147, 1998) (Heinzmann) in view of Park, K. R., et al., "Gaze position detection by computing the three dimensional facial positions and motions," Pattern Recognition, Vol. 35, No. 11, Nov. 2002, pp. 2559-2569 (Park).

Arguments made in rejecting claims 1-9 and 23-29 under 35 USC 103 are analogous to arguments for rejecting claim claims 1-9 and 23-29 under 35 USC 102 made above.

Note that Park teaches using a perspective transformation **(Park: page 2563, col 1, para 1: “perspective camera model”; page 2568, col 1, para 3: “perspective transformation”)**.

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Park into Heinzmann since Heinzmann suggests a system for determining face and gaze positions using a perspective transformation in general and Park suggests the beneficial use of a system for determining face and gaze positions using a perspective transformation as to “ obtain the exact 3D positions of the initial feature points” (Park: page 2568, col 1, para 3) in the analogous art of image processing. It would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Park into Heinzmann since Heinzmann suggests the motivation “precisely models the actual projection” (Heinzmann: page 144, col 1, para 5). Therefore, both the Heinzmann and Park references highlight that the perspective transformation has the benefit of precision. Furthermore, one of ordinary skill in the art at the time the invention was made could have combined the elements as claimed by known methods and, in combination, each component functions the same as it does separately. One of ordinary skill in the art at the time the invention was made would have recognized that the results of the combination would be predictable.

As per claim 10, Heinzmann teaches the image processing apparatus according to Claim 1, wherein the motion estimating means applies Kalman filtering as said filtering **(Heinzmann: See arguments made for rejecting claim 1)**. Heinzmann does not teach extended Kalman filtering.

Park teaches extended Kalman filtering **(Park: page 2564, col 1, para 4: "extended Kalman")**.

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Park into Heinzmann since Heinzmann suggests a system for determining face and gaze positions using Kalman filtering in general and Park suggests the beneficial use of a system for determining face and gaze positions using extended Kalman filtering as to in the analogous art of image processing. It would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Park into Heinzmann since it is well known that the extended Kalman filter is applicable to nonlinear problems whereas the Kalman filter is not. Therefore, one can apply the extended Kalman filter in order to obtain a more robust system. Furthermore, one of ordinary skill in the art at the time the invention was made could have combined the elements as claimed by known methods and, in combination, each component functions the same as it does separately. One of ordinary skill in the art at the time the invention was made would have recognized that the results of the combination would be predictable.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Atiba Fitzpatrick whose telephone number is (571) 270-5255. The examiner can normally be reached on M-F 10:00am-6pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Samir Ahmed can be reached on (571)272-7413. The fax phone number for Examiner Atiba Fitzpatrick is 571-270-6255.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Bhavesh M Mehta/

Supervisory Patent Examiner, Art Unit 2624

Atiba Fitzpatrick

/A. O. F./

Examiner, Art Unit 2624